MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

ECP1026 - ALGORITHM AND DATA STRUCTURE

(All sections / Groups)

10 OCTOBER 2015
2.30 PM – 4.30 PM
(2 Hours)

INSTRUCTION TO STUDENTS

1.This question paper consists of 7 pages including cover page with 5 questions only.

2. Attempt **ALL** the **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) (i) What is data structure? Name any two data structure that can be used in solving complex engineering problems.

[2 marks]

(ii) What is an algorithm? Name any two algorithms that can be used in solving complex engineering problems.

[2 marks]

(iii) Identify the use of them in software development.

[1 mark]

(b) A turnstile, also called a baffle gate, is a form of gate which allows one person to pass at a time. Design a finite-state machine for a turnstile to be used for paid access.

[5 marks]

(c) What are the three things a Turing Machine can do after reading an input from the tape? For the Turing Machine shown in figure 1.c determine the output of the tape and indicate the position of the R/W head at the end of the execution.

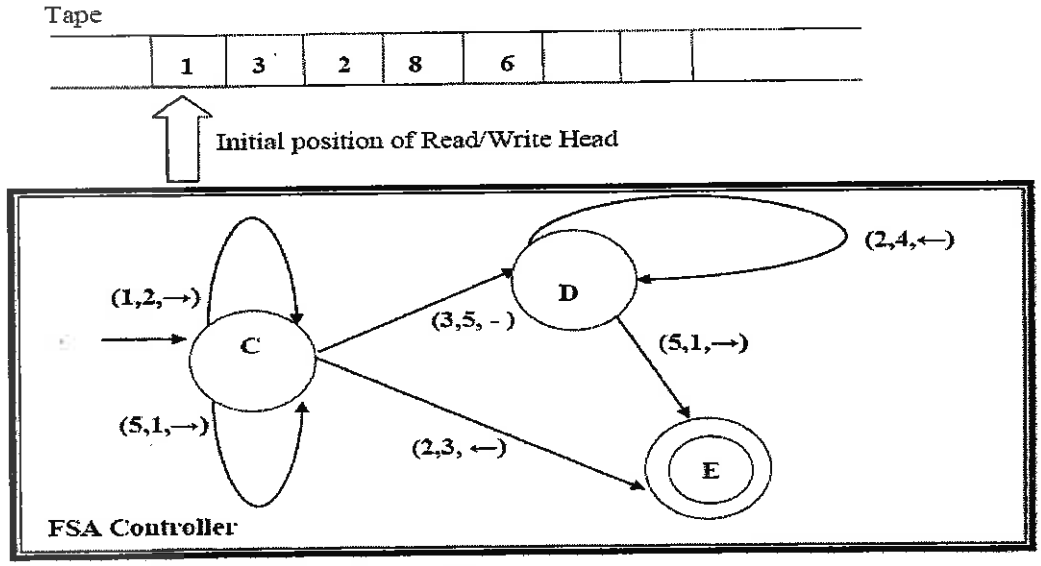


Figure 1.c

[5 marks]

(d) What is the advantage of the call by reference method? Explain when to use call by value and call by reference in a program.

[5 marks]

Continued...

Question 2

(a) State the difference between a variable and a pointer. Write C code to declare a variable to store your name, assign your name to this variable, declare a pointer to point the variable and initialize the pointer.

[5 marks]

(b) Compare an array of structure with a linked list and find any two industrial application of linked list.

[5 marks]

(c) A video rental shop is in the midst of computerizing their business, as a software developer, you need to do the following.

(i) Define a structure called Movie with its name, ID, length in minutes and availability. Also declare an array of structure to hold 100 movies.

[3 marks]

(ii) Make the structure Movie become self-referential, suitable for creating singly linked list.

[1 mark]

(iii) Write the function definition for inserting a node, at the beginning, into a singly linked list which can store the information of movies. Use the following function prototype.
struct Movie *insertLLNode (struct Movie *head);

[4 marks]

(iv) Write a function definition for checking the availability of a movie by giving the ID of the movie.
Note: Assume that the head is declared as a global pointer (declared outside the main function)

[2 marks]

Continued...

Question 3

(a) The mathematical formula to find the slope of a given straight line is represented in the form of a binary tree in figure 3.a. Visit each of the nodes of the binary tree under the following traversals:

(i) Preorder

[2 marks]

(ii) Postorder

[2 marks]

(iii) Inorder

[2 marks]

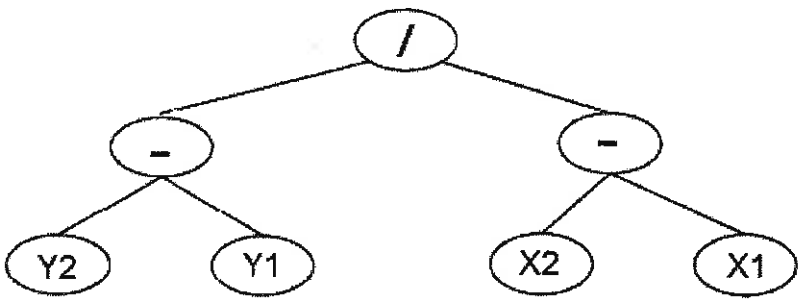
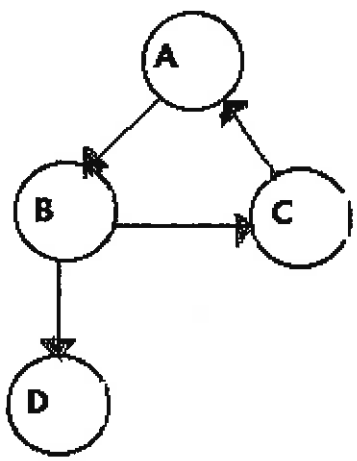


Figure 3.a

(b) Prepare an adjacency matrix for the following graph.

[2 marks]



Write a C program to count the number of vertices in the above graph.

[4 marks]

Continued...

(c) Exponentiation is a mathematical operation, written as b^n, involving two numbers, the base b and the exponent (or power) n. When n is a positive integer, exponentiation corresponds to repeated multiplication of the base: that is, b^n is the product of multiplying n bases:

$$b^n = \underbrace{b \times \cdots \times b}_{n}$$

Write a recursive function to calculate the exponentiation (b^n). Call the function from a suitable main ( ) function.

[6 marks]

(d) State any two applications of back tracking algorithm.

[2 marks]

Question 4

(a) Compare the sequential search and the binary searching algorithms and analyze the time complexity in terms of Big-O notation for the implementation of these searching algorithms using (i) array (ii) linked list data structures.

[6 marks]

(b) Explain the use of Big-O notation in software industry. Find the Big-O notation of the following algorithms and arrange them in order of increasing time complexity.

(i) Traveling salesman algorithm.
(ii) Matrix Multiplication
(iii) Bubble Sort
(iv) Quick Sort
(v) String Comparison
(vi) Binary Search
(vii) Accessing an array element

[7 marks]

Continued...

(c) Given below are the two different solutions to solve the same problem. Let's suppose that we want to create a function that, when given an array of integers greater than 0, will return the integer that is the smallest in that array.
Which solution is efficient? Analyse.

Solution 1:

```
int CompareSmallestNumber (int array[ ])
{
int x, curMin;
curMin = array[0];  // set smallest value to first item in array
/* iterate through array to find smallest value  and also assume there are only 10
elements  */
 for (x = 1; x < 10; x++)
        {
        if( array[x] < curMin)    curMin = array[x];
        }
        return curMin;  // return smallest value in the array
}
```

Solution 2:

```
int CompareToAllNumbers (int array[ ])
{
int isMin; int x, y;
/* iterate through each element in array, assuming there are only 10 elements:  */
for (x = 0; x < 10; x++)
{       isMin = true;
        for (y = 0; y < 10; y++)
        {
/* compare the value in array[x] to the other values  if we find that array[x] is
   greater than any of the  values in array[y] then we know that the value in
   array[x] is not the minimum        */
        if( array[x] > array[y])
        isMin = false;
        }
        if (isMin)  break;
}
return array[x];
}
```

[5 marks]

(d) Asume that there are 256 people in a data base and the computer takes one micro second to check each record. Calculate the time required separately for linear search and binary search, to find the date of birth of the last person in the database.

[2 marks]

Continued...

Question 5

(a) QuickSort is a Divide and Conquer algorithm. It picks an element as pivot and partitions the given array around the picked pivot. Implement the quick sort algorithm in C language picking the last element as pivot. Write a driver program (main function) to sort the array of following elements.

int arr[] = {10, 7, 8, 9, 1, 5}

[10 marks]

(b) Analyze the following piece of code and identify what sorting algorithm could be implemented using this code. Calculate its worst case and best case performance in terms of its time complexity.

```
for(j=0; j<n; j++)
{
        curr=array[j];
        for(k=j; k>0; k--)
        {
                if(array[k-1]<=curr) break;
                array[k]=array[k-1];
        }
        array[k]=curr;
}
```

[3 marks]

(c) When would we use a hash function rather than sequential or binary search?

[2 marks]

(d) A binary search tree is a binary tree in which every node contains a key that satisfies these conditions:

- The key in the left child of the node is less than the key in its parent.
- The key in the right child of the node is more than the key in its parent.

(i) Define a structure BinTreeNode to form a node to store a student name.

(ii) What kind of traversal of binary search tree will result in all the nodes in ascending order? Implement the traversal as a function which has the following function prototype;

void traversal(struct BinTreeNode *node)

[5 marks]

End of paper